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Mortality Trends for Alzheimer's Disease, 1979-91

January 1996



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Center for Health Statistics



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Vital and Health Statistics

Mortality Trends for Alzheimer's Disease, 1979-91

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Statistics System
No. 28

This report presents mortality patterns for Alzheimer's disease, on the basis of both underlying and multiple causes of death. Deaths and death rates are shown by age, race, sex, and State.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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Centers for Disease Control and Prevention
National Center for Health Statistics

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Symbols

- - - Data not available
 - . . . Category not applicable
 - Quantity zero
 - * Figure does not meet standard of reliability or precision (estimate is based on fewer than 20 deaths in numerator or denominator)
 - *— Figure does not meet standard of reliability and quantity zero
-

Mortality Trends for Alzheimer's Disease, 1979–91

by Donna L. Hoyert, Ph.D., Division of Vital Statistics

Highlights

In 1991 a record 14,112 Alzheimer's deaths were reported in the United States, 13,768 of which were to persons 65 years of age and older. Alzheimer's disease would have been the 11th leading cause of death for individuals 65 years of age and older if it were separately identified in the standard tabulation list used to rank leading causes.

Death rates increased with age for this cause. The age-specific death rates for persons 85 years and over were about 19 times greater than those for persons 65–74 years of age. The age-adjusted death rate for this cause, which eliminates the effects of the aging of the population, increased each year from 1979 to 1988. However, from 1988 to 1991 there was no

statistically significant single-year increase. The increasing trend may reflect improvements in diagnosis, awareness of the condition within the medical community, and other unidentified factors rather than substantial changes in the risk of dying from Alzheimer's disease.

Age-adjusted death rates for Alzheimer's disease are greater for men than women and for the white than the black population. During the period from 1979 to 1991, the mortality sex ratio for the elderly decreased from 1.6 to 1.1 and the ratio of the rates by race decreased from 2.6 to 1.7. Geographic differentials also occur in death rates for Alzheimer's disease.

In addition to the deaths for which Alzheimer's disease is reported as the underlying or initiating cause of death, Alzheimer's disease is mentioned on many other death certificates as an additional condition contributing to death. A similar increase has occurred between 1979 and 1991 for reporting Alzheimer's disease as an additional cause as for when it is reported as the underlying cause of death.

Increases also occurred over this period for a broader group of dementing conditions, including Alzheimer's disease. Among these, variations occurred in both the patterns and trends of mortality.

Notes: This report was prepared in the Division of Vital Statistics under the general direction of Harry M. Rosenberg, Chief of the Mortality Statistics Branch. Gopal K. Singh, Ph.D., Mortality Statistics Branch, and Joan Van Nostrand, M.P.A., NCHS Coordinator of Data on Aging, peer-reviewed this report. Betty L. Smith of the Statistical Resources Branch provided content review. Staff of the Registration Methods Branch and the Technical Services Branch provided consultation to State vital statistics offices regarding collection of the death certificate data on which this report is based. This report was edited by Gail V. Johnson and typeset by Annette F. Holman of the Publications Branch, Division of Data Services.

Introduction

This report presents basic data on Alzheimer's disease mortality between 1979–91. Alzheimer's is a progressively debilitating disease that falls within a class of disorders, generally referred to as dementia. These disorders, characterized by cognitive and mental deterioration, may manifest in sudden or progressive forms. Within the class of disorders, the major type of progressive dementia is Alzheimer's disease (1).

In addition to memory loss and increasing difficulty in doing cognitive tasks, persons with Alzheimer's disease also have problems with emotional outbursts, personal care, disrupted sleep patterns, and control of bodily functions (2). The timing of the progression of this disease to death varies widely for individuals. In the end, death has been reported in clinical texts to occur because of pulmonary infections, urinary tract infections, decubitus ulcers or bed sores, or iatrogenic disorders (3).

The purpose of this report is to describe trends for this cause of death by age, race, and sex; to describe geographic differentials; to discuss Alzheimer's disease as a multiple cause of death; and to present mortality data on other dementing conditions. Data are shown for all ages, but as this condition primarily affects the older population, patterns for those 65 years of age and older are emphasized.

Data source

The mortality data in this report are from the National Vital Statistics System. The medical information collected on the death certificate focuses on the sequence of medical conditions that result in death and is provided in a two-part format as recommended by the World Health Organization (WHO)(4). The U.S. Standard Certificate of Death (figure 1) is designed principally to elicit a single disease or injury that started the morbid process that lead to death; this disease or injury is usually reported on the bottom line of part I and is called the underlying cause of death. Traditionally, the underlying cause is the datum by which mortality statistics are tabulated in both the United States and other countries. Other conditions are usually reported on the death certificate in either part I of the certificate—representing the sequence of conditions leading to death, or part II—representing other conditions that the physician felt had a bearing on the death but were not part of the direct causal sequence. The totality of all conditions on the death certificate, either underlying or nonunderlying, is called multiple causes of death. The United States is one of a few countries that routinely and annually produce both underlying and multiple cause-of-death statistics (for additional information, see Technical notes).

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27. PART I. Enter the diseases, injuries, or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

IMMEDIATE CAUSE (Final disease or condition resulting in death) →

Sequentially list conditions, if any, leading to immediate cause. Enter **UNDERLYING CAUSE** (Disease or injury that initiated events resulting in death) **LAST**

a. _____ DUE TO (OR AS A CONSEQUENCE OF):

b. _____ DUE TO (OR AS A CONSEQUENCE OF):

c. _____ DUE TO (OR AS A CONSEQUENCE OF):

d. _____

Approximate Interval Between Onset and Death

PART II. Other significant conditions contributing to death but not resulting in the underlying cause given in Part I.

28a. WAS AN AUTOPSY PERFORMED? (Yes or no)

28b. WERE AUTOPSY FINDINGS AVAILABLE PRIOR TO COMPLETION OF CAUSE OF DEATH? (Yes or no)

29. MANNER OF DEATH

☐ Natural

☐ Pending Investigation

☐ Accident

☐ Suicide

☐ Homicide

☐ Could not be Determined

30a. DATE OF INJURY (Month, Day, Year)

30b. TIME OF INJURY

M

30c. INJURY AT WORK? (Yes or no)

30d. DESCRIBE HOW INJURY OCCURRED

30e. PLACE OF INJURY—At home, farm, street, factory, office building, etc. (Specify)

30f. LOCATION (Street and Number or Rural Route Number, City or Town, State)

Figure 1. Medical Certification of Death (Cause of Death) section of the U.S. Standard Certificate of Death

Cause-of-death information is completed by a qualified person: physician, medical examiner, or coroner. The person filling out the cause-of-death section of the death certificate is asked to provide, to the best of his or her knowledge and based on available medical history and clinical and pathological evidence, the sequence of conditions that caused death. The death certificate includes a statement about medical certification being to the best of his or her knowledge in recognition of the fact that determination of cause may be difficult, but that the physician is in the best position to make a judgment about the chain of events leading to death (5).

The medical conditions reported by physicians, medical examiners, and coroners on the death certificate are translated into medical codes for statistical use. The translation is made using the classification structure and the selection and modification rules contained in the applicable revision of the *International Classification of Diseases* (ICD), published by WHO (for additional information, see Technical notes). Use of the ICD promotes comparability of mortality statistics worldwide. In this classification, Alzheimer's disease (ICD-9 No. 331.0) is found in Chapter VI "Diseases of the Nervous System and Sense Organs." Alzheimer's disease might be reported as either an underlying or nonunderlying cause of death, reflecting the physician's judgment about this medical condition's role in the death.

Cause-of-death data from the death certificate are the most widely available, timely, and geographically comparable data on health available for the United States and many other countries. However, the reliability and accuracy of cause-of-death statistics are dependent upon the ability of the certifier to make the proper diagnosis and the care with which he or she records this information on the death certificate (5).

Diagnosis

Many mental and cognitive exams have been used to diagnose Alzheimer's disease, with the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA) criteria being most widely used (6–8). The NINCDS-ADRDA specify criteria for clinical diagnosis of possible, probable, and definite Alzheimer's disease. Criteria for possible Alzheimer's disease are least discriminating and those for definite Alzheimer's disease are most discriminating. Definite Alzheimer's disease criteria include the clinical criteria used to diagnose probable Alzheimer's disease plus anatomical evidence available only upon an autopsy (7,8). The accuracy of diagnosing Alzheimer's disease has improved over time, largely because of the development of the NINCDS-ADRDA criteria. Research in the 1970's found that Alzheimer's disease was confirmed in 60–70 percent of suspected cases; more recent research reports verification of more than 90 percent of suspected Alzheimer's disease cases (9). Improved diagnoses have a number of potential benefits, including promoting comparability of research on treatment and enhancing statistical estimates of morbidity and mortality.

Reporting Alzheimer's disease on the death certificate

Research on reporting dementia on death certificates shows that substantial numbers of death certificates for persons diagnosed

with dementia have no mention of the condition, but the percentage depends on the specific type of dementia (10–13). Burns et al. (12) and Newens et al. (13) report that neither Alzheimer's disease nor any other type of dementia is mentioned on a quarter to a third of death certificates for diagnosed persons.

Upon death, Alzheimer's disease might not be mentioned on a death certificate for several reasons, including the following: the condition was not diagnosed, Alzheimer's was diagnosed but was not considered to contribute to death, and the condition was not reported although it may have contributed to death. Aside from an item that identifies decedents for whom an autopsy was conducted, no further information is available on the death certificate that would indicate if Alzheimer's disease was diagnosed or what diagnostic tests had been performed or even if the autopsy results were used in completing the death certificate. Such information could only be obtained by further inquiry, or by linking the death certificate to other sources of information such as a patient's medical records or hospital discharge records.

If the medical personnel reporting the cause of death believe that the person had Alzheimer's disease, but that this was not relevant in the person's death, then not mentioning Alzheimer's disease on the death certificate would be an acceptable procedure. In fact, the death certificate only asks for those causes of death that contribute to the individual's death. For this reason, death certificates would underestimate the number of decedents who have Alzheimer's disease at the time of death, as with other chronic conditions (14).

With respect to the possibility of a reporting problem when Alzheimer's disease is diagnosed and does contribute to death, some evidence suggests that reporting of dementing conditions on death certificates is improving over time (13). When the course of a dementing condition has progressed so that the person is more severely affected cognitively, Alzheimer's disease and infectious conditions are reported with greater frequency (15).

Another reporting artifact that has been suggested as contributing toward the increase in Alzheimer's disease deaths is an increasing preference for the term "Alzheimer's disease" over other terms (16). Depending on the terms used, a death could be classified under other titles in the ICD.

Implications of composition change in the population

The burden of Alzheimer's disease is expected to increase because of changes in the population composition (8). Because of lower fertility rates in recent decades and declines in death rates, the proportion of the population 65 years of age and older has grown substantially. Within the elderly population, the distribution has changed to reflect aging within the elderly subpopulation (17–19). The proportion of the elderly population 85 years of age and over is projected to continue to increase until the large baby boom cohort begins to move into age groups 65 years and older (18,19).

Trends, 1979–91

In 1991 a total of 14,112 deaths from Alzheimer's disease were reported in the United States, an increase of 13,255 (about sixteenfold) from the 857 reported in 1979 (table 1). By and large, this is a condition of the elderly population; of the 14,112 deaths in 1991, a total of 13,768 (or 98 percent) were to people aged 65 years and over (table 1).

Between 1979 and 1991 the age-adjusted death rate for Alzheimer's disease increased twelvefold, from 2.5 to 29.3 per 100,000 population 65 years of age and over, while mortality from all causes decreased 8.5 percent (table 2). Rates for persons 65 years and over increased each year until 1988 when the rates reached a plateau. Differences in rates for successive years between 1988 and 1991 were not statistically significant, although the increase during the 3-year period 1988–91 was statistically significant. The average annual increase was 50 percent between 1979 and 1983, 22 percent between 1983 and 1987, and 2 percent between 1987 and 1991 (table A).

Mortality for Alzheimer's disease, like that of most chronic diseases, increases with age. In the case of Alzheimer's disease, this pattern became more pronounced between 1979 and 1991 (figure 2). In 1979 rates for individuals 85 years and over were 2.0 times greater than the rates for individuals 65–74 years of age. By 1991, rates for the oldest

age group were 19.3 times that for individuals 65–74 years of age (table 3).

The divergence in rates by age reflects a slower increase in mortality for the younger age groups, 65–74 and 75–84 years of age compared with persons 85 years of age and over. Since 1988, rates have decreased for the 65–74 year age group and stabilized for the 75–84 year age group while rates for the 85 years and over group have continued to increase. While recent increases have occurred within the open-ended category of 85 years and over and rates do indeed increase for 10-year age groups within the 85 years and over category (table B), changes in the composition of this segment of the population have not affected the age-adjusted rate.

Sex

Age-adjusted death rates for Alzheimer's disease are somewhat greater for men than for women (figure 3). In 1991, the rate for men age 65 years and over was 30.8 compared with 28.1 for women, a difference of 10 percent (table 2). For women, rates increased almost every year from 1979 to 1991 while for men increases appear to have stopped around 1987. Throughout the period, rates were consistently greater for males than females; however, the mortality sex ratio decreased from 1.6 in 1979 to 1.1 in 1991. In comparison, the ratio for all causes was 1.7 in 1979 and 1.6 in 1991.

Race

Age-adjusted death rates are greater for the white than for the black population (table 2 and figure 4). In 1991 the age-adjusted death rate for Alzheimer's disease for the elderly white population (30.6) was 1.7 times that of the black population (18.5). Between 1979 and 1991, this ratio decreased from 2.6 to 1.7. For all causes, the ratio was 0.9 in 1979 and 0.8 in 1991.

Geographic differentials, 1989–91

Age-adjusted death rates for Alzheimer's disease by State of residence are shown for the 3-year period 1989–91 in table 4. Rates differ by State, with the largest rates being observed for persons 65 years of age and over in States in the northwestern and northeastern areas of the United States (figure 5). The lowest rates are for States in the Middle Atlantic region. The rate for the State with the greatest rate is about five times that for the State with the lowest rate. For all

Table A. Age-adjusted death rates for Alzheimer's disease for decedents 65 years of age and over and annual percent change: United States, 1979–91

[Age-adjusted rates per 100,000 U.S. standard million population; see appendix]

Year	All races		
	Age-adjusted rate ¹	Confidence interval	Annual percent change
1991	29.3	(28.8,29.8)	–1.0
1990	29.6	(29.1,30.1)	1.4
1989	29.2	(28.7,29.7)	2.5
1988	28.5	(28.0,29.0)	5.2
1987	27.1	(26.6,27.6)	14.3
1986	23.7	(23.2,24.2)	9.7
1985	21.6	(21.1,22.1)	27.1
1984	17.0	(16.6,17.4)	36.0
1983	12.5	(12.1,12.9)	68.9
1982	7.4	(7.1, 7.7)	48.0
1981	5.0	(4.7, 5.3)	31.6
1980	3.8	(3.6, 4.0)	52.0
1979	2.5	(2.3, 2.7)	---

¹Includes age not stated.

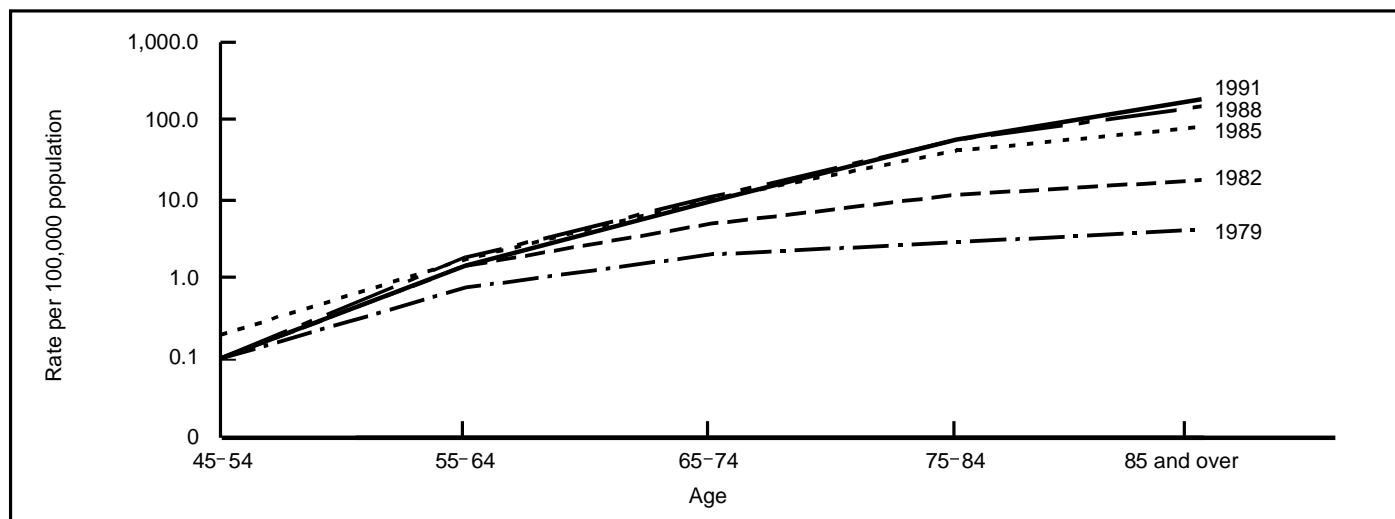


Figure 2. Death rates for Alzheimer's disease by age: United States, 1979–91

Table B. Age-specific and age-adjusted death rates for Alzheimer's disease for decedents 65 years of age and over: United States, 1990

[Age-adjusted rates per 100,000 U.S. standard million population; see appendix]

Age	Age-specific death rate ¹
65 years and over	43.1
65–74	10.2
75–84	58.6
85 years and over	187.8
85–94	176.5
95 years and over	319.6
	Age-adjusted death rate ¹
Based on 10-year age groups up to 85 years and over	29.6
Based on 10-year age groups up to 95 years and over	29.5

¹Includes age not stated.

causes, the rate for the State with the greatest rate is only 1.4 times that for the State with the lowest rate. It seems improbable that there would be a fivefold variation in the incidence of Alzheimer's disease but more likely that there are reporting differences across States.

By race, the geographic pattern for the white population is generally the same as for all races. One difference is for Hawaii, which has a low age-adjusted rate for the elderly of all races relative to the rate for the United States as a whole but a high rate for the white population. For the black population, few differences in State rates are statistically significant from the rate for the United States as a whole. In those specific States—Illinois, Massachusetts, Michigan, Missouri, New York, New Jersey, and Texas—the rates are in the same direction as for the white population, but the northeastern and northwestern pattern of the highest rates observed for the entire United States is not evident for the black population.

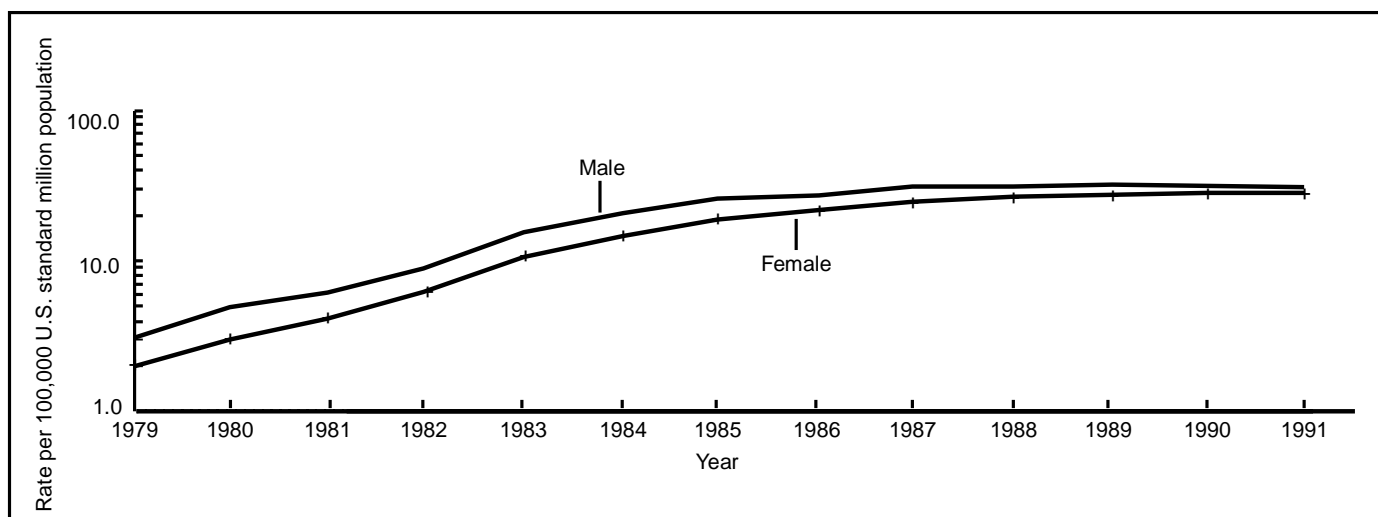


Figure 3. Age-adjusted death rates by sex for Alzheimer's disease for persons 65 years of age and over: United States, 1979–91

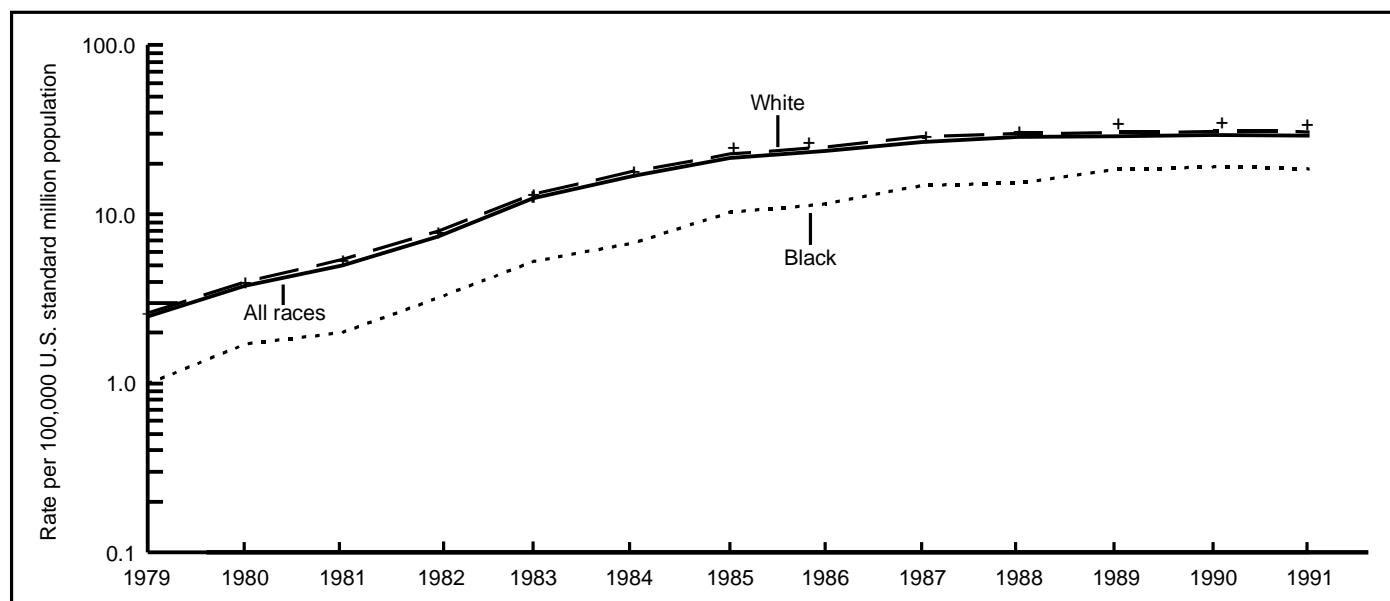


Figure 4. Age-adjusted death rates by race for Alzheimer's disease for persons 65 years of age and over: United States, 1979–91

Multiple causes of death

On a multiple-cause basis, age-adjusted death rates for Alzheimer's disease have also increased. In 1979 the rate for the total population was 4.9 per 100,000 population 65 years of age and over compared with 66.6 in 1991, approximately a thirteenfold increase (table 5). The ratio of the multiple-cause rate to the underlying cause rate has been stable at about 2.3 for the last 8 years.

A broader grouping of dementing conditions

The perspective can be broadened to include additional medical conditions that are grouped together in this report and referred to as dementing conditions. These ICD-9 categories include Alzheimer's disease (ICD-9 No. 331.0), Senility (ICD-9 No. 797), Senile and presenile organic psychotic conditions (ICD-9 No. 290), and Other cerebral degenerations (ICD-9 No. 331.1–331.9). The rationale for considering a broader group of conditions includes the following:

- deaths reported to be caused by Alzheimer's disease prior to the introduction of ICD-9 in 1979 were classified under Senile and presenile dementia (ICDA-8 No. 290) (20)
- it has been suggested that the increasing trend for Alzheimer's disease may reflect increasing preference for the term Alzheimer's disease over terms that would be classified under other titles in ICD-9 (16)

- it is possible that some Alzheimer's deaths end up being classified under other titles even with a separate title introduced in ICD-9

For all of these conditions combined, death rates also increased between 1979 and 1991 (table 6). In 1979, the rate was 13.3 per 100,000 population 65 years and over compared with 52.7 in 1991, a fourfold increase. However, trends differ for specific dementing conditions resulting in a smaller increase over the time period than was observed for Alzheimer's disease by itself.

Like Alzheimer's disease, rates for Senile and presenile organic psychotic conditions increased throughout the period, from 4.1 to 19.2 per 100,000 population 65 years and over. In contrast, for Senility and Other cerebral degenerations, the rates decreased from 2.9 to 2.3 and 3.8 to 2.0 for the two causes, respectively. Because Senility is considered an ill-defined condition, a death certificate would normally be queried if this is reported as the underlying cause. Because of the query process, the certifying physician may provide more detailed information on the medical conditions resulting in death. Therefore, decreases in the death rate for this cause may reflect better medical certification practices over time rather than real reductions in the incidence of this condition as a reported cause of death.

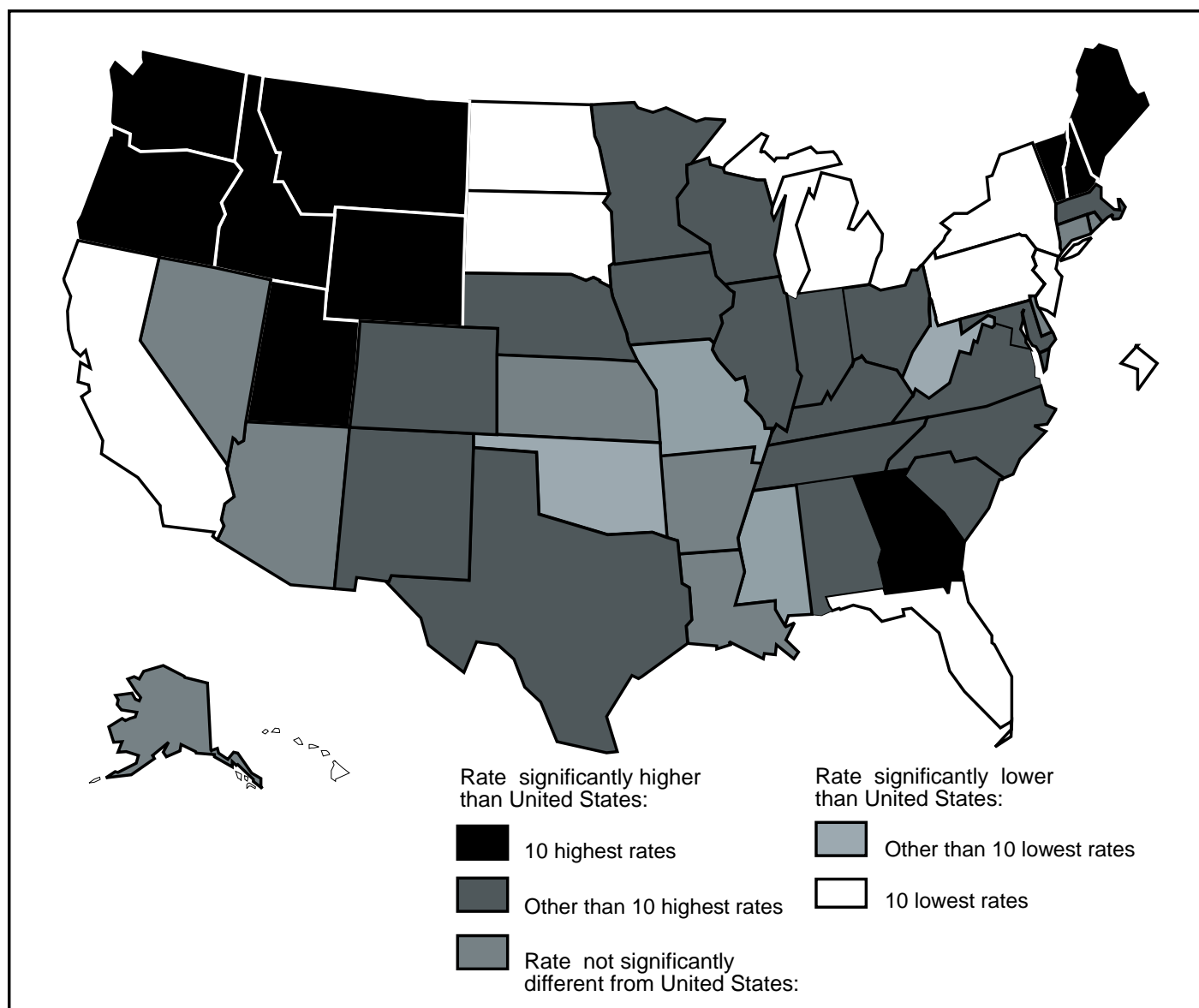


Figure 5. Alzheimer's disease death rates by State, 1989-91

Discussion

Although the number of deaths caused by Alzheimer's disease is much less than the numbers for heart disease and cancer (21), many deaths are reported to be caused by Alzheimer's disease. Furthermore, death from Alzheimer's disease increased significantly from 1979 to 1988 and was stable from 1988 to 1991. Given the number of deaths, Alzheimer's disease would be the 11th leading cause of death for individuals 65 years of age and over each year from 1987 to 1991 if it were ranked according to NCHS standards (see Technical notes). In the future, Alzheimer's disease will be a rankable cause. The increasing trend in the number of reported deaths from Alzheimer's disease may reflect improvements in diagnosis and reporting, wider knowledge of the condition within the medical community, and other unidentified factors rather than substantial changes in the risk of dying from Alzheimer's disease.

Possible reasons for the increase in the number of reported deaths from Alzheimer's disease include the changing age composition of the population, improving medical technology for diagnosis, and expanding awareness of the condition. As more of the population survives to very old ages, Alzheimer's disease has increased because the condition is more prevalent at very old ages. In addition, as medical technology can control other morbid and mortal conditions, Alzheimer's disease may be observed in a population that might have died earlier at ages when the risk for Alzheimer's disease was lower. In a death rate measure, changes in the age composition of the population can be taken into account. Death rates from Alzheimer's disease continue to increase when adjusted to account for changes in the age distribution of the population. Therefore, changes in age composition may contribute to increases in the number of deaths but do not fully explain the increase as is clear from examining age-adjusted death rates.

The increasing trend in the number of deaths and rates may, in part, be explained by a change toward using the term "Alzheimer's disease" rather than terms that would be classified to other titles in the ICD-9. Although decreases in the use of the term, Senility, for example, may contribute to an increase in the number of deaths from Alzheimer's disease, the broader group of dementing conditions is also increasing. Consequently, a shift in terms written on the death certificate

does not completely account for the increase. The increase also cannot be explained by changes in the selection of Alzheimer's disease as the underlying cause of death by certifying physicians, since similar increases occurred for Alzheimer's disease as both an underlying and as a multiple cause of death.

Increased awareness and publicity of Alzheimer's disease could motivate the medical community to examine individuals specifically for the condition or to encourage them to diagnose the condition without appropriate diagnostic measures. The potential contribution of either of these possible reporting artifacts to increasing the number of deaths and rates from Alzheimer's disease remains unknown because death certificates do not contain any information to make this type of estimate.

Databases with information on diagnostic methods used and more detail on individual medical histories could shed some light on issues relating reporting artifacts. The best check on the quality of the data in the vital statistics data files is the subset of records for which the death was autopsied. A comparison was made between trends and patterns in mortality from Alzheimer's disease between those records that showed an autopsy was done and those records that showed no autopsy was done. The patterns between the two sets were similar (22) suggesting that the reasons for an increase have nothing to do with the evidence obtained at the autopsy. For instance, increased acceptance of Alzheimer's disease as a condition that contributes to death could result in general changes in reporting practices. That is, Alzheimer's disease might be reported more frequently for both deaths that are and deaths that are not autopsied if medical personnel become more willing to consider this condition a cause of death.

Consequently, trend data on Alzheimer's disease show an increasing trend but the source of the increase is not as clear. Increases in Alzheimer's disease seems to result from improved reporting, possibly because of several factors—including diagnostic improvements (9), increases in awareness of the condition, changes in terminology used, or changes in the acceptance of Alzheimer's disease as a cause of death. Changes in terminology and medical practices have been linked to increases in other causes of death (23,24).

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Table 1. Deaths for Alzheimer's disease by race, sex, and age: United States, 1979–91

[Alzheimer's disease deaths are those assigned to ICD–9 category number 331.0]

Year and age	All races			White			Black		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages ¹									
1991	14,112	5,070	9,042	13,401	4,787	8,614	660	265	395
1990	13,744	4,992	8,752	13,020	4,675	8,345	662	281	381
1989	13,110	4,970	8,140	12,443	4,692	7,751	618	259	359
1988	12,281	4,732	7,549	11,730	4,515	7,215	499	193	306
1987	11,311	4,545	6,766	10,801	4,329	6,472	463	193	270
1986	9,426	3,862	5,564	9,037	3,708	5,329	347	130	217
1985	8,258	3,523	4,735	7,917	3,383	4,534	310	121	189
1984	6,250	2,803	3,447	6,032	2,712	3,320	197	81	116
1983	4,434	2,021	2,413	4,256	1,935	2,321	156	74	82
1982	2,627	1,208	1,419	2,533	1,166	1,367	87	37	50
1981	1,757	831	926	1,691	797	894	61	30	31
1980	1,314	653	661	1,258	619	639	53	31	22
1979	857	429	428	818	408	410	33	18	15
65 years and over ¹									
1991	13,768	4,913	8,855	13,089	4,643	8,446	630	253	377
1990	13,391	4,822	8,569	12,693	4,518	8,175	639	270	369
1989	12,734	4,783	7,951	12,105	4,521	7,584	585	244	341
1988	11,842	4,518	7,324	11,322	4,309	7,013	470	185	285
1987	10,877	4,328	6,549	10,401	4,132	6,269	438	177	261
1986	8,984	3,650	5,334	8,631	3,513	5,118	318	117	201
1985	7,819	3,323	4,496	7,513	3,202	4,311	277	104	173
1984	5,846	2,615	3,231	5,649	2,533	3,116	177	72	105
1983	4,039	1,842	2,197	3,882	1,764	2,118	136	66	70
1982	2,261	1,029	1,232	2,175	993	1,182	79	31	48
1981	1,473	685	788	1,420	659	761	49	22	27
1980	1,037	526	511	996	500	496	39	24	15
1979	653	329	324	629	315	314	22	12	10

¹Includes age not stated.

Table 2. Age-adjusted death rates for Alzheimer's disease by race, sex, and age: United States, 1979–91

[Alzheimer's disease deaths are those assigned to ICD–9 category number 331.0. Age-adjusted rates per 100,000 U.S. standard million population; see appendix]

Year and age	All races			White			Black		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages ¹									
1991	2.1	2.2	2.1	2.2	2.3	2.2	1.4	1.6	1.3
1990	2.2	2.3	2.1	2.3	2.4	2.2	1.4	1.8	1.2
1989	2.1	2.3	2.0	2.2	2.4	2.1	1.4	1.7	1.2
1988	2.1	2.3	2.0	2.2	2.4	2.1	1.2	1.2	1.1
1987	2.0	2.3	1.8	2.1	2.4	1.9	1.1	1.3	1.0
1986	1.8	2.0	1.6	1.9	2.1	1.7	0.9	0.9	0.9
1985	1.6	1.9	1.5	1.7	2.0	1.5	0.8	0.9	0.8
1984	1.3	1.6	1.1	1.4	1.7	1.2	0.5	0.6	0.5
1983	1.0	1.2	0.9	1.1	1.3	0.9	0.4	0.5	0.4
1982	0.6	0.7	0.6	0.7	0.8	0.6	0.3	0.3	0.2
1981	0.5	0.5	0.4	0.5	0.6	0.4	0.2	0.2	0.2
1980	0.4	0.4	0.3	0.4	0.5	0.3	0.2	0.3	0.1
1979	0.2	0.3	0.2	0.3	0.3	0.2	0.1	*	*
65 years and over ¹									
1991	29.3	30.8	28.1	30.6	32.2	29.5	18.5	21.7	16.5
1990	29.6	31.6	28.3	30.9	32.6	29.7	19.1	24.1	16.1
1989	29.2	32.1	27.3	30.5	33.5	28.6	18.4	22.3	16.0
1988	28.5	31.3	26.7	30.0	33.0	28.1	15.3	17.1	14.3
1987	27.1	31.0	24.6	28.5	32.7	25.9	14.8	16.7	13.6
1986	23.7	27.2	21.5	25.0	28.9	22.6	11.5	11.9	11.1
1985	21.6	25.7	18.9	22.8	27.3	19.9	10.3	10.7	9.9
1984	17.0	20.9	14.6	18.1	22.3	15.4	6.8	7.3	6.4
1983	12.5	15.3	10.7	13.2	16.2	11.3	5.3	6.9	4.3
1982	7.4	8.9	6.3	7.9	9.5	6.8	3.2	3.3	3.2
1981	5.0	6.2	4.1	5.4	6.5	4.5	2.0	2.5	1.7
1980	3.8	4.9	3.0	4.0	5.2	3.2	1.7	2.6	*
1979	2.5	3.1	2.0	2.6	3.3	2.2	1.0	*	*

¹Includes age not stated.

Table 3. Age-specific death rates for Alzheimer's disease by race, sex, and year: United States, 1979–91

[Alzheimer's disease deaths are those assigned to ICD–9 category number 331.0. Age-specific rates per 100,000 population in specified group; age-adjusted rates per 100,000 U.S. standard million population; see appendix]

Race, sex, and age	All ages	Under 1 year	1–4 years	5–14 years	15–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65 years and over				
										Total	65–74 years	75–84 years	85 years and over	
All races														
Both sexes:														
1991	5.6	*	*	*	*	*	*	0.1	1.5	43.4	9.9	57.4	190.7	
1990	5.5	*	*	*	*	*	*	0.1	1.5	43.1	10.2	58.6	187.8	
1989	5.3	*	*	*	*	*	*	0.1	1.7	41.5	10.6	58.6	170.4	
1988	5.0	*	*	*	*	*	*	0.1	1.9	39.3	11.3	57.2	151.2	
1987	4.7	*	*	*	*	*	*	0.1	1.9	36.7	11.1	54.7	135.4	
1986	3.9	*	*	*	*	*	*	0.1	1.9	31.0	10.9	46.9	103.7	
1985	3.5	*	*	*	*	*	*	0.2	1.8	27.5	10.5	42.2	86.1	
1984	2.7	*	*	*	*	*	*	0.1	1.6	21.0	9.3	31.8	59.8	
1983	1.9	*	*	*	*	*	*	0.1	1.6	14.8	7.8	21.4	37.8	
1982	1.1	*	*	*	*	*	*	0.1	1.5	8.4	5.1	12.2	17.9	
1981	0.8	*	*	*	*	*	*	0.2	1.1	5.6	3.8	7.2	12.2	
1980	0.6	*	*	*	*	*	*	0.1	1.1	4.1	3.2	4.8	7.6	
1979	0.4	*	*	*	*	*	*	0.1	0.8	2.6	2.1	3.0	4.3	
Male:														
1991	4.1	*	*	*	*	*	*	*	1.5	38.4	10.8	62.2	184.6	
1990	4.1	*	*	*	*	*	*	0.2	1.5	38.6	11.6	63.3	182.6	
1989	4.1	*	*	*	*	*	*	*	1.7	38.8	11.8	67.5	165.9	
1988	4.0	*	*	*	*	*	*	*	1.9	37.3	12.2	65.5	152.5	
1987	3.9	*	*	*	*	*	*	*	1.9	36.4	12.9	64.4	138.6	
1986	3.3	*	*	*	*	*	*	*	1.9	31.4	12.6	55.1	108.5	
1985	3.0	*	*	*	*	*	*	*	1.8	29.2	12.8	50.8	93.7	
1984	2.4	*	*	*	*	*	*	*	1.6	23.4	11.2	40.2	69.5	
1983	1.8	*	*	*	*	*	*	*	1.6	16.8	9.2	28.0	42.8	
1982	1.1	*	*	*	*	*	*	*	1.6	9.6	5.9	15.7	18.8	
1981	0.7	*	*	*	*	*	*	*	1.2	6.5	4.7	9.3	12.7	
1980	0.6	*	*	*	*	*	*	*	1.1	5.1	4.3	5.9	9.4	
1979	0.4	*	*	*	*	*	*	*	0.8	3.2	2.6	3.8	7.1	
Female:														
1991	7.0	*	*	*	*	*	*	*	1.5	46.7	9.2	54.6	193.1	
1990	6.9	*	*	*	*	*	*	*	1.5	46.1	9.2	55.8	189.9	
1989	6.4	*	*	*	*	*	*	*	1.6	43.3	9.7	53.4	172.2	
1988	6.0	*	*	*	*	*	*	*	1.8	40.6	10.5	52.2	150.8	
1987	5.4	*	*	*	*	*	*	*	1.8	36.9	9.7	48.9	134.1	
1986	4.5	*	*	*	*	*	*	*	1.8	30.7	9.5	42.1	101.8	
1985	3.9	*	*	*	*	*	*	*	1.8	26.4	8.7	37.2	83.1	
1984	2.8	*	*	*	*	*	*	*	1.7	19.3	7.8	26.9	55.8	
1983	2.0	*	*	*	*	*	*	*	1.7	13.4	6.8	17.5	35.7	
1982	1.2	*	*	*	*	*	*	*	1.4	7.8	4.3	10.1	17.6	
1981	0.8	*	*	*	*	*	*	*	1.0	4.9	3.0	6.0	12.0	
1980	0.6	*	*	*	*	*	*	*	1.1	3.4	2.3	4.1	6.8	
1979	0.4	*	*	*	*	*	*	*	0.8	2.2	1.8	2.6	3.0	
White														
Both sexes:														
1991	6.4	*	*	*	*	*	*	0.1	1.5	45.8	10.4	59.9	200.4	
1990	6.2	*	*	*	*	*	*	0.2	1.5	45.3	10.7	61.0	196.4	
1989	6.0	*	*	*	*	*	*	*	1.7	43.7	11.1	61.1	179.2	
1988	5.7	*	*	*	*	*	*	0.2	2.0	41.6	11.8	60.3	159.1	
1987	5.3	*	*	*	*	*	*	0.1	1.9	38.9	11.6	57.5	142.6	
1986	4.4	*	*	*	*	*	*	0.1	1.9	32.9	11.4	49.6	109.8	
1985	3.9	*	*	*	*	*	*	0.2	1.9	29.2	11.0	44.9	90.8	
1984	3.0	*	*	*	*	*	*	0.1	1.7	22.4	9.9	33.8	63.5	
1983	2.1	*	*	*	*	*	*	0.1	1.7	15.7	8.3	22.6	39.5	
1982	1.3	*	*	*	*	*	*	0.2	1.6	9.0	5.5	12.8	19.0	
1981	0.9	*	*	*	*	*	*	0.2	1.2	6.0	4.1	7.7	12.8	
1980	0.6	*	*	*	*	*	*	0.1	1.2	4.3	3.4	5.1	7.9	
1979	0.4	*	*	*	*	*	*	0.1	0.8	2.8	2.3	3.2	4.4	

Table 3. Age-specific death rates for Alzheimer's disease by race, sex, and year: United States, 1979–91—Con.

[Alzheimer's disease deaths are those assigned to ICD–9 category number 331.0. Age-specific rates per 100,000 population in specified group; age-adjusted rates per 100,000 U.S. standard million population; see appendix]

Race, sex, and age	All ages	Under 1 year	1–4 years	5–14 years	15–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65 years and over				
										Total	65–74 years	75–84 years	85 years and over	
White–Con.														
Male:														
1991	4.6	*	*	*	*	*	*	*	1.5	40.2	11.3	64.5	194.9	
1990	4.6	*	*	*	*	*	*	0.2	1.5	40.0	11.9	64.9	192.5	
1989	4.6	*	*	*	*	*	*	*	1.8	40.6	12.2	70.1	176.4	
1988	4.5	*	*	*	*	*	*	*	2.0	39.4	12.7	69.1	162.2	
1987	4.3	*	*	*	*	*	*	*	2.0	38.4	13.5	68.0	146.7	
1986	3.7	*	*	*	*	*	*	*	2.0	33.4	13.2	58.5	117.3	
1985	3.4	*	*	*	*	*	*	*	1.8	31.1	13.3	54.5	100.9	
1984	2.8	*	*	*	*	*	*	*	1.7	25.1	12.0	43.0	74.7	
1983	2.0	*	*	*	*	*	*	*	1.7	17.8	9.7	29.6	45.4	
1982	1.2	*	*	*	*	*	*	*	1.7	10.2	6.3	16.7	20.2	
1981	0.8	*	*	*	*	*	*	*	1.3	6.9	5.0	9.8	13.5	
1980	0.7	*	*	*	*	*	*	*	1.2	5.4	4.6	6.2	9.5	
1979	0.4	*	*	*	*	*	*	*	0.9	3.4	2.8	4.1	7.1	
Female:														
1991	8.0	*	*	*	*	*	*	*	1.5	49.6	9.7	57.1	202.5	
1990	7.8	*	*	*	*	*	*	*	1.6	48.8	9.7	58.6	197.9	
1989	7.3	*	*	*	*	*	*	*	1.6	45.9	10.3	55.7	180.4	
1988	6.8	*	*	*	*	*	*	*	1.9	43.1	11.0	55.2	157.9	
1987	6.2	*	*	*	*	*	*	*	1.9	39.2	10.2	51.3	140.9	
1986	5.1	*	*	*	*	*	*	*	1.9	32.6	10.0	44.4	106.9	
1985	4.4	*	*	*	*	*	*	*	1.9	28.0	9.1	39.3	86.8	
1984	3.2	*	*	*	*	*	*	*	1.8	20.6	8.3	28.4	59.1	
1983	2.3	*	*	*	*	*	*	*	1.8	14.3	7.3	18.6	37.1	
1982	1.3	*	*	*	*	*	*	*	1.6	8.1	4.8	10.5	18.5	
1981	0.9	*	*	*	*	*	*	*	1.1	5.4	3.4	6.4	12.5	
1980	0.6	*	*	*	*	*	*	*	1.2	3.6	2.5	4.4	7.2	
1979	0.4	*	*	*	*	*	*	*	0.8	2.3	1.9	2.7	3.3	
Black														
Both sexes:														
1991	2.1	*	*	*	*	*	*	*	1.4	24.7	7.0	37.9	96.6	
1990	2.2	*	*	*	*	*	*	*	1.1	25.6	7.1	39.3	102.9	
1989	2.1	*	*	*	*	*	*	*	1.6	23.7	7.4	38.9	81.4	
1988	1.7	*	*	*	*	*	*	*	1.4	19.4	7.6	28.5	68.2	
1987	1.6	*	*	*	*	*	*	*	1.2	18.4	7.0	29.6	58.7	
1986	1.2	*	*	*	*	*	*	*	1.4	13.6	6.6	21.2	36.8	
1985	1.1	*	*	*	*	*	*	*	1.5	12.0	6.7	15.8	37.4	
1984	0.7	*	*	*	*	*	*	*	*	7.8	3.9	12.7	19.5	
1983	0.6	*	*	*	*	*	*	*	*	6.1	3.4	8.8	17.4	
1982	0.3	*	*	*	*	*	*	*	*	3.6	2.0	6.2	*	
1981	0.2	*	*	*	*	*	*	*	*	2.3	1.5	*	*	
1980	0.2	*	*	*	*	*	*	*	*	1.9	*	*	*	
1979	0.1	*	*	*	*	*	*	*	*	1.1	*	*	*	
Male:														
1991	1.8	*	*	*	*	*	*	*	*	25.8	8.6	46.1	100.0	
1990	1.9	*	*	*	*	*	*	*	*	28.2	9.5	53.8	95.1	
1989	1.8	*	*	*	*	*	*	*	*	25.7	9.4	49.8	75.8	
1988	1.4	*	*	*	*	*	*	*	*	19.7	8.0	35.1	64.6	
1987	1.4	*	*	*	*	*	*	*	*	19.1	8.2	33.3	60.9	
1986	0.9	*	*	*	*	*	*	*	*	12.8	7.3	23.3	*	
1985	0.9	*	*	*	*	*	*	*	*	11.5	7.7	16.3	*	
1984	0.6	*	*	*	*	*	*	*	*	8.1	4.3	13.1	*	
1983	0.6	*	*	*	*	*	*	*	*	7.4	4.0	13.8	*	
1982	0.3	*	*	*	*	*	*	*	*	3.5	*	*	*	
1981	0.2	*	*	*	*	*	*	*	*	2.5	*	*	*	
1980	0.2	*	*	*	*	*	*	*	*	2.8	*	*	*	
1979	*	*	*	*	*	*	*	*	*	*	*	*	*	

Table 3. Age-specific death rates for Alzheimer's disease by race, sex, and year: United States, 1979–91—Con.

[Alzheimer's disease deaths are those assigned to ICD–9 category number 331.0. Age-specific rates per 100,000 population in specified group; age-adjusted rates per 100,000 U.S. standard million population; see appendix]

Race, sex, and age	All ages	Under 1 year	1–4 years	5–14 years	15–24 years	25–34 years	35–44 years	45–54 years	55–64 years	65 years and over				
										Total	65–74 years	75–84 years	85 years and over	
Black–Con.														
Female:														
1991	2.4	*	*	*	*	*	*	*	*	24.0	6.0	33.3	95.1	
1990	2.4	*	*	*	*	*	*	*	*	24.0	5.5	31.1	106.2	
1989	2.3	*	*	*	*	*	*	*	*	22.5	6.1	32.7	84.3	
1988	2.0	*	*	*	*	*	*	*	1.8	19.2	7.4	24.7	69.8	
1987	1.7	*	*	*	*	*	*	*	*	17.9	6.1	27.4	57.6	
1986	1.4	*	*	*	*	*	*	*	*	14.1	6.0	20.0	44.2	
1985	1.3	*	*	*	*	*	*	*	*	12.4	6.0	15.5	42.1	
1984	0.8	*	*	*	*	*	*	*	*	7.7	3.6	12.5	17.8	
1983	0.6	*	*	*	*	*	*	*	*	5.2	2.9	5.7	18.5	
1982	0.3	*	*	*	*	*	*	*	*	3.7	*	6.4	*	
1981	0.2	*	*	*	*	*	*	*	*	2.1	*	*	*	
1980	0.2	*	*	*	*	*	*	*	*	*	*	*	*	
1979	*	*	*	*	*	*	*	*	*	*	*	*	*	

Table 4. Death rates and age-adjusted death rates for Alzheimer's disease by State: United States, 1989–91

[Rates per 100,000 population in specified group and area. Age-adjusted rates per 100,000 U.S. standard million population; see appendix. Decedents with not stated age are excluded. Data by place of residence exclude deaths occurring in the United States to nonresidents]

State	Death rate						Age-adjusted death rate					
	All ages			Age 65 and over			All ages			Age 65 and over		
	All races	White	Black	All races	White	Black	All races	White	Black	All races	White	Black
Alabama	6.3	7.6	2.9	47.4	53.1	26.3	2.6	2.9	1.3	34.8	39.5	18.0
Alaska	*	*	*	*	*	*	*	*	*	*	*	*
Arizona	5.6	6.1	*	41.6	42.9	*	2.2	2.3	*	30.6	31.5	*
Arkansas	5.8	6.7	*	38.1	41.5	*	2.0	2.3	*	28.4	31.2	*
California	3.9	4.5	2.0	35.9	38.8	26.7	1.9	2.0	1.7	25.1	26.7	21.6
Colorado	5.3	5.6	*	53.1	53.7	*	2.5	2.6	*	36.6	36.8	*
Connecticut	6.0	6.6	*	43.0	44.0	*	2.1	2.1	*	28.6	29.0	*
Delaware	4.7	5.3	*	38.4	40.1	*	2.1	2.1	*	29.7	30.7	*
District of Columbia	4.1	7.3	2.7	32.4	57.0	21.3	1.5	2.0	1.2	21.7	29.4	16.9
Florida	6.7	7.7	1.8	36.1	37.0	24.1	1.8	1.9	1.4	25.1	25.5	18.4
Georgia	5.7	7.1	2.1	55.0	62.7	25.9	3.0	3.4	1.5	40.2	46.0	19.5
Hawaii	3.6	6.2	*	31.9	68.5	*	1.6	3.4	*	22.9	49.3	*
Idaho	7.1	7.3	*	57.9	58.3	*	2.9	2.9	*	39.0	39.1	*
Illinois	5.8	6.5	2.9	45.0	46.4	37.3	2.2	2.2	1.9	30.8	31.5	28.2
Indiana	6.0	6.3	2.3	46.2	47.6	23.0	2.5	2.5	1.3	32.6	33.6	15.4
Iowa	9.7	9.9	*	62.3	62.5	*	2.5	2.5	*	35.3	35.3	*
Kansas	6.9	7.2	*	49.0	49.2	*	2.2	2.2	*	30.8	30.8	*
Kentucky	6.3	6.6	*	48.5	50.3	*	2.5	2.5	*	34.1	35.4	*
Louisiana	4.5	5.8	2.0	39.2	45.1	20.9	2.2	2.6	1.3	29.3	33.7	16.3
Maine	10.1	10.2	*	74.5	74.4	*	3.5	3.5	*	47.2	47.3	*
Maryland	5.2	6.5	1.8	46.7	51.0	26.4	2.4	2.6	1.4	33.5	35.9	20.8
Massachusetts	8.2	8.8	3.5	59.3	59.7	57.6	2.7	2.7	3.0	36.9	36.9	42.8
Michigan	3.9	4.4	1.6	31.9	33.7	17.6	1.7	1.8	1.1	23.3	24.4	14.7
Minnesota	7.9	8.3	*	62.5	63.3	*	2.6	2.6	*	36.4	36.8	*
Mississippi	4.5	5.7	2.5	34.2	38.4	24.2	2.0	2.2	1.5	25.5	28.8	18.1
Missouri	5.7	6.2	2.2	39.5	41.0	20.0	1.8	1.9	1.2	25.7	26.6	11.7
Montana	12.0	12.9	*	88.5	90.6	*	4.1	4.1	*	55.6	56.9	*
Nebraska	7.9	8.2	*	55.4	55.4	*	2.3	2.4	*	32.9	33.1	*
Nevada	3.7	4.0	*	33.0	33.9	*	2.2	2.2	*	29.0	29.6	*
New Hampshire	8.7	8.8	*	75.8	76.2	*	3.3	3.3	*	46.7	46.7	*
New Jersey	4.0	4.7	1.2	29.2	30.5	16.0	1.5	1.7	0.8	21.2	21.9	12.6
New Mexico	5.4	5.9	*	50.0	51.5	*	2.6	2.7	*	35.9	37.2	*
New York	2.4	2.9	0.6	17.6	19.0	7.3	0.9	0.9	0.4	12.1	12.9	5.8
North Carolina	6.3	7.5	2.7	50.8	55.8	27.5	2.8	2.9	1.6	37.0	40.6	20.5
North Dakota	6.0	6.3	*	40.6	40.7	*	1.8	1.9	*	23.8	23.9	*
Ohio	6.4	6.9	2.8	48.2	49.9	29.5	2.4	2.4	1.6	32.8	33.7	23.0
Oklahoma	5.3	6.1	*	38.1	40.9	*	1.9	2.0	*	26.0	27.7	*
Oregon	10.1	10.6	*	72.8	73.8	*	3.3	3.4	*	47.5	48.0	*
Pennsylvania	4.9	5.2	2.6	31.0	31.5	24.1	1.6	1.6	1.3	22.3	22.5	19.3
Rhode Island	7.6	8.1	*	50.5	51.4	*	2.3	2.3	*	31.9	32.2	*
South Carolina	5.5	6.9	2.5	46.9	53.4	26.5	2.8	3.1	1.9	37.2	41.9	22.9
South Dakota	5.7	6.2	*	38.8	39.4	*	1.7	1.7	*	24.7	25.1	*
Tennessee	6.4	7.2	2.5	49.7	53.2	24.9	2.5	2.7	1.3	35.7	38.4	16.3
Texas	4.8	5.3	2.6	46.3	48.0	32.9	2.4	2.6	1.7	32.6	33.6	22.9
Utah	6.6	6.9	*	73.4	74.9	*	3.8	3.9	*	51.8	52.8	*
Vermont	10.0	10.1	*	83.6	83.9	*	3.6	3.6	*	50.2	50.5	*
Virginia	5.2	6.1	2.5	47.9	52.5	27.4	2.5	2.6	1.6	35.1	37.8	22.4
Washington	8.6	9.3	*	71.6	73.6	*	3.3	3.4	*	46.9	47.7	*
West Virginia	5.4	5.4	*	35.0	34.7	*	1.8	1.8	*	25.5	25.2	*
Wisconsin	8.2	8.7	*	60.9	61.5	*	2.7	2.7	*	37.6	37.9	*
Wyoming	7.0	7.2	*	67.1	67.5	*	3.1	3.2	*	44.8	44.9	*

Table 5. Age-adjusted multiple cause death rates for Alzheimer's disease; and ratio of multiple cause rates to underlying cause rates by race and age: United States, 1979–91

[Alzheimer's disease deaths are those assigned to ICD–9 category number 331.0. Age-adjusted rates per 100,000 U.S. standard million population; see appendix]

Year and age	All races		White		Black	
	Multiple cause	Ratio	Multiple cause	Ratio	Multiple cause	Ratio
All ages ¹						
1991	4.8	2.29	5.0	2.27	3.6	2.57
1990	4.9	2.23	5.1	2.22	3.4	2.43
1989	4.8	2.29	5.0	2.27	3.3	2.36
1988	4.9	2.33	5.1	2.32	3.1	2.57
1987	4.5	2.25	4.7	2.24	2.7	2.45
1986	4.0	2.23	4.2	2.21	2.2	2.46
1985	3.6	2.25	3.8	2.24	1.8	2.29
1984	2.9	2.24	3.1	2.20	1.3	2.66
1983	2.1	2.12	2.2	2.00	0.9	2.35
1982	1.3	2.18	1.4	1.99	0.6	2.00
1981	0.9	1.82	1.0	1.92	0.5	2.45
1980	0.7	1.73	0.7	1.83	0.3	1.45
1979	0.5	2.40	0.5	1.67	0.2	2.40
65 years and over						
1991	66.6	2.27	69.0	2.25	48.4	2.62
1990	67.6	2.28	70.3	2.28	46.3	2.42
1989	66.8	2.29	69.5	2.28	44.2	2.40
1988	67.1	2.35	70.1	2.34	41.2	2.69
1987	61.9	2.28	64.8	2.27	35.5	2.40
1986	55.0	2.32	57.8	2.31	29.2	2.54
1985	49.0	2.27	51.8	2.27	22.8	2.21
1984	38.4	2.26	40.7	2.25	17.0	2.50
1983	27.2	2.18	28.8	2.18	11.7	2.21
1982	15.8	2.14	16.7	2.12	7.5	2.34
1981	10.8	2.16	11.3	2.09	5.4	2.70
1980	7.5	1.97	8.0	2.00	2.8	1.64
1979	4.9	1.96	5.2	2.01	2.1	2.11

¹Includes age not stated.

Table 6. Deaths and age-adjusted death rates for Alzheimer's disease and selected dementing conditions among the elderly: United States, 1979–91

[Alzheimer's disease deaths are those assigned to ICD–9 category number 331.0; Other cerebral degenerations 331.1–331.9; Senile and presenile organic psychotic conditions 290.0–290.9; Senility 797. Age-adjusted rates per 100,000 U.S. standard million population; see appendix]

<i>Year</i>	<i>Alzheimer's disease</i>		<i>Other cerebral degenerations</i>		<i>Senile and presenile organic psychotic conditions</i>		<i>Senility</i>		<i>Total</i>	
	<i>Number</i>	<i>Rate</i>	<i>Number</i>	<i>Rate</i>	<i>Number</i>	<i>Rate</i>	<i>Number</i>	<i>Rate</i>	<i>Number</i>	<i>Rate</i>
1991	13,768	29.3	833	2.0	9,957	19.2	1,412	2.3	25,970	52.7
1990	13,391	29.6	863	2.1	8,750	17.4	1,303	2.2	24,307	51.3
1989	12,736	29.2	859	2.1	7,967	16.2	1,271	2.2	22,831	49.7
1988	11,842	28.5	925	2.3	6,608	13.9	1,411	2.5	20,786	47.2
1987	10,877	27.1	982	2.5	5,471	11.8	1,191	2.1	18,521	43.5
1986	8,984	23.7	946	2.6	4,296	9.5	1,286	2.4	15,512	38.2
1985	7,819	21.6	1,025	2.8	3,737	8.6	1,343	2.5	13,924	35.5
1984	5,846	17.0	1,042	2.9	3,083	7.1	1,261	2.4	11,232	29.5
1983	4,039	12.5	1,128	3.3	2,624	6.4	1,266	2.5	9,057	24.6
1982	2,261	7.4	1,101	3.4	2,208	5.6	1,178	2.5	6,748	18.9
1981	1,473	5.0	1,109	3.6	2,022	5.3	1,062	2.3	5,666	16.2
1980	1,037	3.8	1,159	3.9	1,644	4.5	1,223	2.8	5,063	15.0
1979	653	2.5	1,094	3.8	1,435	4.1	1,229	2.9	4,411	13.3

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Appendix

Technical notes on methods

Nature and sources of data

Data in this report are based on information from all death certificates filed in the 50 States and the District of Columbia. The State death certificates conform closely to the U.S. Standard Certificate of Death, which is developed in a cooperative effort between the National Center for Health Statistics (NCHS) and the States. The U.S. Standard Certificate of Death was revised in 1989. For additional details see the 1989 revision of the U.S. standard certificates and reports and Technical Appendix of *Vital Statistics of the United States*, Volume II, Mortality (25,26).

Mortality statistics are based on information coded by the States and provided to NCHS through the Vital Statistics Cooperative Program (VSCP) and from copies of the original certificates received by NCHS from the State registration offices. In 1991 all the States and the District of Columbia participated in this program and submitted part or all of the mortality data for 1991 on computer tape to NCHS. The 31 States in the VSCP that submitted precoded medical data for all deaths on computer tapes are Alaska, Arkansas, California, Colorado, Delaware, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New Hampshire, New York State (excluding New York City), North Carolina, North Dakota, Pennsylvania, South Carolina, Texas, Vermont, Virginia, Washington, Wisconsin, and Wyoming. In 1991 Delaware, Idaho, Maine, North Dakota, Vermont, and Wyoming contracted with a private company to provide NCHS with precoded medical data. Kansas continued to provide the medical data for Alaska. The remaining 19 VSCP States, New York City, and the District of Columbia submitted copies of the original certificates from which NCHS coded the medical data. For 1991 all States submitted precoded demographic data for all deaths.

Data for the entire United States refer to events occurring within the United States. Data shown for geographic areas are by place of residence. Beginning with 1970, mortality statistics exclude deaths of nonresidents of the United States. All data exclude fetal deaths.

Cause-of-death classification

The mortality statistics presented here were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify causes of

death by the current *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death* (4). Causes of death for 1979–91 were classified according to the Ninth Revision of the manual (ICD–9). For earlier years causes of death were classified according to the revisions then in use—1968–78, Eighth Revision; 1958–67, Seventh Revision; and 1949–57, Sixth Revision. Changes in classification of causes of death due to these revisions may result in discontinuities in cause-of-death trends. Consequently, cause-of-death comparisons among revisions require consideration of comparability ratios and, where available, estimates of their standard errors. Comparability ratios between the Eighth and Ninth Revisions, between the Seventh and Eighth Revisions, and between the Sixth and Seventh Revisions may be found in other NCHS reports (27–29).

Besides specifying the classification, WHO regulations outline the form of medical certification and the procedures to be used in coding cause of death. Cause-of-death data presented in this publication were coded by procedures outlined in annual issues of the *NCHS Instructional Manual* (30–32).

Prior to data for 1968, mortality medical data were based on manual coding of an underlying cause of death for each certificate in accordance with WHO rules. Effective with data year 1968, NCHS converted to computerized coding of the underlying cause and manual coding of all causes (multiple causes) on the death certificate. In this system, called “Automated Classification of Medical Entities” (ACME) (33), the multiple cause codes serve as inputs to the computer software that employs WHO rules to select the underlying cause. Many States also have implemented ACME and provide multiple cause and underlying cause data to NCHS in electronic form.

Beginning with data year 1990, another computer system was implemented. This system, called “Mortality Medical Indexing, Classification, and Retrieval” (MICAR) (34,35), automates coding multiple causes of death. In addition, MICAR can provide more detailed information on the conditions reported on death certificates than is available through the International Classification of Diseases (ICD) code structure. In the first year of implementation, only about 5 percent (94,372) of the Nation’s death records were coded using MICAR with subsequent processing through ACME. For 1991 approximately 26 percent (573,416) of the Nation’s death records were coded using MICAR. The following States implemented MICAR on at least a portion of their 1991 data: Arkansas, Florida, Indiana, and Washington. NCHS expanded the use of MICAR to code at least a portion of the records

from the following States: Alabama, Connecticut, Hawaii, Kentucky, Missouri, Montana, Nevada, New Mexico, Ohio, Oregon, Rhode Island, South Dakota, Tennessee, Utah, West Virginia, the District of Columbia, and New York City. The remainder of the national file was processed by either NCHS or the States using only the ACME system.

The underlying cause is defined by WHO as the disease or injury that initiated the sequence of events leading directly to death or as the circumstances of the accident or violence that produced the fatal injury. It is selected from the conditions entered by the physician in the cause-of-death section of the death certificate. When more than one cause or condition is entered by the physician, the underlying cause is determined by the sequence of conditions on the certificate, provisions of the ICD, and associated selection rules. Generally, more medical information is reported on death certificates than is directly reflected in the underlying cause of death.

Multiple causes of death

Multiple cause-of-death data allow for the maximum use of medical information reported on the death certificate depending on the certifying physician's evaluation of the part each condition played in the death and on the physician's desire and ability to report that evaluation on the death certificate. Multiple cause data provide information on diseases that are a factor in death whether or not they are the underlying cause of death; on associations among diseases; and on injuries leading to death. They also give information that will aid in the evaluation and strengthening of the certification process, thereby improving the quality of the medical information entered on the death certificate. However, it is reasonable to assume that not all conditions present at death are reported on the death certificate and that variation in reporting depends on a number of factors, including the nature of the conditions that brought about death.

Quality of reporting of cause of death

Although deaths occur for which the underlying causes are impossible to determine, the proportion of death certificates coded to the Ninth Revision Chapter XVI, Symptoms, signs, and ill-defined conditions (ICD-9 Nos. 780-799) shows the care and consideration given to the certification by the medical certifier. This proportion also may be used as a rough measure of the specificity of the medical diagnoses made by the certifier in various areas. In 1991, 1.12 percent of all reported deaths in the United States were assigned to Symptoms, signs, and ill-defined conditions (ICD-9 Nos. 780-799), the same as 1990.

Population bases for computing rates

The population used for computing death rates shown in this report (furnished by the U.S. Bureau of the Census) represents the population residing in the specified area. Death rates for 1991 are based on population estimates as of July 1, 1991 (36,37). The estimates are based on the 1990 census

counts. Death rates for 1981-89 shown in the report have been recomputed, based on revised populations for those years that are consistent with the 1990 census levels (36). They are, therefore, not comparable with death rates published in earlier NCHS publications for those data years.

Cause-of-death rankings

Cause-of-death rankings by NCHS are based on the List of 72 Selected Causes of Death and HIV infection (ICD-9 Nos. *042-*044). The List was developed for use with mortality data beginning with the 1979 data year, when ICD-9 was implemented in the United States. At that time, deaths from Alzheimer's disease (ICD-9 No. 331.0) were not sufficiently important numerically to be included as a separate category in the List; instead, they were combined with other conditions in the residual category "All other diseases." However, Alzheimer's disease will appear as a separate category when ICD-10 is implemented in the United States (38).

Since 1979, a major change has been made in the list of rankable causes, namely, that NCHS introduced category numbers *042-*044 for classifying and coding Human immunodeficiency virus (HIV) infection, and it was added to the list beginning with data for 1987. The asterisk before the category numbers indicates that these codes are not part of the *Ninth Revision of the International Classification of Diseases* (ICD-9).

The group titles Major cardiovascular diseases and Symptoms, signs, and ill-defined conditions are not ranked from the List of 72 Selected Causes. In addition, category titles that begin with the words "Other" and "All Other" are not ranked to determine the leading causes of death. When one of the titles that represents a subtotal is ranked (for example, Tuberculosis), its component parts are not ranked (in this case, Tuberculosis of respiratory system and Other tuberculosis).

Age-adjusted rates

Age-adjusted death rates are used to make comparisons of relative mortality risks across groups and over time. However, they should be viewed as constructs or indexes rather than as direct or actual measures of mortality risk. Statistically, they are weighted averages of the age-specific death rates, where the weights represent the fixed population proportions by age (39). The age-adjusted rates presented in this report were computed by the direct method, that is, by applying the age-specific death rates for a given cause of death to the U.S. standard million population (relative age distribution of 1940 enumerated population of the United States over 65 years of age (40)). Using the same standard population, the rates for the total population and for each race-sex group were adjusted separately. The age-adjusted rates were based on 10-year age groups. In table B, an age-adjusted rate is calculated with a modified standard. The modification involved extending the upper age limit from 85 years and over to 95 years and over. It is important not to compare age-adjusted death rates with crude rates.

Random variation

Although the mortality data in this report (except data for 1972) are not subject to sampling error, they may be affected by random variation in the number of deaths involved. When the number of events is small (perhaps less than 100) and the probability of such an event is small, considerable caution must be observed in interpreting the data. Such infrequent events may be assumed to follow a Poisson probability distribution. For this distribution, a simple approximation may be used to estimate the confidence interval, as follows:

If N is the number of registered deaths in the population and R is the corresponding rate, the chances are 19 in 20 (approximate 95-percent confidence interval) that

$$1. \quad N - 2\sqrt{N} \quad \text{and} \quad N + 2\sqrt{N}$$

covers the “true” number of events.

$$2. \quad R - 2\frac{R}{\sqrt{N}} \quad \text{and} \quad R + 2\frac{R}{\sqrt{N}}$$

covers the “true” rate.

If the rate R_1 corresponding to N_1 events is compared with the rate R_2 corresponding to N_2 events, the difference between the two rates may be regarded as statistically significant if it exceeds

$$2\sqrt{\frac{R_1^2}{N_1} + \frac{R_2^2}{N_2}}$$

Additional information on random variation may be found in the Technical Appendix of *Vital Statistics of the United States*, Volume II, Mortality (26).

State map

Assigning the States into the given categories on the map was carried out in two steps: first, determining whether the State death rate differed significantly from the corresponding U.S. rate at the 0.05 level of significance and second, grouping the State rates found to be significantly different from the U.S. rate into the four categories:

- 10 highest State rates of those significantly greater than the U.S. rate
- remaining State rates significantly greater than the U.S. rate
- 10 lowest State rates of those significantly lower than the U.S. rate
- remaining State rates significantly lower than the U.S. rate

Different procedures were used to determine tests of statistical significance and confidence intervals, depending on the number of deaths.

For 50 deaths or more, the standard normal Z statistic was used to perform the significance test:

$$Z = (R'_S - R'_{US}) / \sqrt{S^2(R'_S) + S^2(R'_{US})}$$

where

R'_S = age-adjusted rate for 1989–91 for the given State per 100,000 U.S. standard million population

R'_{US} = age-adjusted rate for 1989–91 for the United States per 100,000 U.S. standard million population

$S^2(R'_S)$ = estimated variance of the age-adjusted death rate for 1989–91 for the State

$S^2(R'_{US})$ = estimated variance of the age-adjusted death rate for 1989–91 for the United States

The variance of the age-adjusted death rate was computed in terms of the variances of age-specific death rates (41) under the assumption that the age-specific death rates are binomial proportions (42). The 95-percent confidence limits were estimated as follows:

$$\text{Lower limit} = R'_S - 1.96 * S(R'_S)$$

and

$$\text{Upper limit} = R'_S + 1.96 * S(R'_S)$$

For 1–49 deaths, the lower and upper 95-percent confidence limits were estimated as described elsewhere (43). The difference between the State and U.S. rates was determined to be statistically significant at the 0.05 level if the rates' respective 95-percent confidence limits did not overlap.

Rates, proportions, and ratios

Beginning with 1989 data, an asterisk is shown in place of a rate based on fewer than 20 deaths. These rates have a relative standard error of 23 percent or more and are, therefore, considered statistically unreliable. For age-adjusted death rates, this criterion is applied to the sum of the age-specific deaths.

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For answers to questions about this report or for a list of reports published in these series, contact:

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